

Port of Ponce, Guayanilla, Yabucoa, and Las Mareas, Puerto Rico, After Action Report

Introduction.

A Port Risk Assessment was conducted for the port of Ponce, Guayanilla, Yabucoa, and Las Mareas, Puerto Rico (South Central Puerto Rico) 9 – 10 February 2000. This report will provide the following information:

- Brief description of the process used for the assessment;
- List of participants;
- Numerical results from the Analytical Hierarchy Process (AHP); and
- Summary of risks and mitigations discussion.

Follow-on strategies to develop and implement unmitigated risks will be the subject of a separate report.

Process.

The risk assessment process is a disciplined approach to obtaining expert judgements on the level of waterway risk. The process also addresses the relative merit of specific types of Vessel Traffic Management (VTM) improvements for reducing risk in the port. Based on the Analytic Hierarchy Process (AHP)¹, the port risk assessment process involves convening a select group of expert/stakeholders in each port and conducting structured workshops to evaluate waterway risk factors and the effectiveness of various VTM improvements. The process requires the participation of local Coast Guard officials before and throughout the workshops. Identification of local risk factors/drivers and selecting appropriate risk mitigation measures is thus accomplished by a joint effort involving experts and stakeholders, including both waterway users and the agencies/entities responsible for implementing selected risk mitigation measures.

This methodology hinges on the development of a generic model of vessel casualty risk in a port. Since risk is defined as the product of the probability of a casualty and its consequences, the model includes variables associated with both the causes and the effects of vessel casualties. The model uses expert opinion to weight the relative contribution of each variable to the overall port risk. The experts are then asked to establish scales to measure each variable. Once the parameters have been established for each risk-inducing factor, the port's risk is estimated by inputting values for the variables specific to that port into the risk model. The model also produces an index of relative merit for five VTM levels as perceived by the local experts assembled for each port.

¹ Developed by Dr Thomas L. Saaty, et al to structure complex decision making, to provide scaled measurements, and to synthesize many factors having different dimensions.

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Participants.

The following is a list of stakeholders/experts that participated in the process:

Participant	Organization	E-mail address
Mr. Alberto Sola	Phillips Core, Inc.	asola@prco.com
Mr. John Hennon	Phillips Core, Inc.	jrhenn@ppco.com
Mr. Pedro Rivera	Puerto Rico Operations	Fax: 787.281.8114
Mr. Edert Ortiz	CORCO	corco@caribe.net
Mr. Ramon Ramos	CORCO	corco@caribe.net
Capt. Jose Rivera	Caribbean Harbor Pilots	rivto@hotmail.com
Capt. Domenico Rognoni	Carnival Cruise Lines	
Capt. Alex Cruz	Caribbean Harbor Pilots	alexz@coqui.net
LT Dave Xirau	U. S. Coast Guard	dxirau@msosanjuan.uscg.mil
LT Carlos Torres	U. S. Coast Guard	ctorres@rioborinquen.uscg.mil
Mr. Mariano Velazquez	U. S. Coast Guard Auxiliary	marianovelazquez@hotmail.com
Mr. Henry F. McLeod	Puerto Rico Sun Oil, Inc.	henry_f_mcleod_matsonsunoil.com
Mr. Jose Morales	Puerto Rico Sun Oil, Inc.	
Mr. Efrain Lopez	ECO Electrica	lefrain.lopen@enfor.com
Mr. Gabriel Duran	Puerto Rico Port Control	
Mr. Miguel Maltes	Pro Caribe	
Mr. Luis de Jesus	Luis Ayala Colon, Inc.	agencypc@ayacol.com
Mr. Ramon Vega	Port of Ponce	puerto@coqui.net
Mr. Felix Rios	U. S. Coast Guard Auxiliary	
Capt. Michael Romanelli	LEEVAC	mjrjr@capebridge.net
LT Michael Putlock	U. S. Coast Guard	mputlock@gantsec.uscg.mil
BMC John Prentice	U. S. Coast Guard	jprentice@antpuertorico.uscg.mil
Assessment Team Members		
LT Dave Murk	U. S. Coast Guard	dmurk@comdt.uscg.mil
Mr. Jorge Arroyo	U. S. Coast Guard	jrooy@comdt.uscg.mil
Mr. Robert Moore	COASTWATCH	rmoore@coastwatch.com
Mr. Chuck Klingler	SOZA	chuck_klingler@soza.com
Mr. Doug Perkins	SOZA	doug_perkins@soza.com
Mr. Jim Koshar	Q Systems	jamesk@qsystems.net

Numerical Results.

Book 1 - Factors *(Generic Weights sum to 100)*

Fleet Composition 17.3	Traffic Conditions 6.8	Navigational Conditions 21.4	Waterway Configuration 19.1	Short-term Consequences 21.7	Long-term Consequences 13.7
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Analysis:

The participants contributed the above scores to the National Model. They determined that the Short Term Consequences and Navigational Conditions are the largest drivers of risk. Please note that these are ports that only handle a vessel at a time.

Book 2 - Risk Subfactors *(Generic Weights)*

Fleet Composition 17.3	Traffic Conditions 6.8	Navigational Conditions 21.4	Waterway Configuration 19.1	Short-term Consequences 21.7	Long-term Consequences 13.7
% High Risk Deep Draft 13.8	Volume Deep Draft 2.9	Wind Conditions 4.1	Visibility Obstructions 4.2	Volume of Passengers 3.7	Economic Impacts 3.3
% High Risk Shallow Draft 3.5	Volume Shallow Draft 0.9	Visibility Conditions 8.0	Passing Arrangements 3.6	Volume of Petroleum 7.5	Environmental Impacts 4.2
	Vol. Fishing & Pleasure Craft 1.1	Currents, Tides, Rivers 5.8	Channel and Bottom 4.1	Volume of Chemicals 10.5	Health & Safety Impacts 6.1
	Traffic Density 1.9	Ice Conditions 3.5	Waterway Complexity 7.1		

Analysis:

The participants contributed the above results to the national model. Subfactors contributing the most to overall risk under each of the six major factors were:

- For the Fleet Composition factor, High-Risk Deep Draft Vessels contribute a very high number.
- For Traffic Conditions, Volume of Deep Draft contributes the greatest amount of risk to the waterway.
- For Navigational Conditions, Visibility Conditions contribute the most.
- For Waterway Configuration, Waterway Complexity contributes the most followed by Passing Arrangements.
- For Short Term Consequences, The Volume of Chemicals contributes the highest risk factor.
- For Long Term Consequences, Health and Safety contribute the most.

Book 3 Subfactor Scales - Condition List (Generic)

	<i>Scale Value</i>
Wind Conditions	
a. Severe winds < 2 days / month	1.0
b. Severe winds occur in brief periods	2.8
c. Severe winds are frequent & anticipated	5.4
d. Severe winds occur without warning	9.0
Visibility Conditions	
a. Poor visibility < 2 days/month	1.0
b. Poor visibility occurs in brief periods	2.8
c. Poor visibility is frequent & anticipated	5.2
d. Poor visibility occurs without warning	9.0
Current, Tide or River Conditions	
a. Tides & currents are negligible	1.0
b. Currents run parallel to the channel	2.6
c. Transits are timed closely with tide	5.8
d. Currents cross channel/turns difficult	9.0
Ice Conditions	
a. Ice never forms	1.0
b. Some ice forms-icebreaking is rare	2.6
c. Icebreakers keep channel open	5.8
d. Vessels need icebreaker escorts	9.0
Visibility Obstructions	
a. No blind turns or intersections	1.0
b. Good geographic visibility-intersections	2.2
c. Visibility obscured, good communications	5.2
d. Distances & communications limited	9.0
Passing Arrangements	
a. Meetings & overtakings are easy	1.0
b. Passing arrangements needed-ample room	2.4
c. Meetings & overtakings in specific areas	5.9
d. Movements restricted to one-way traffic	9.0
Channel and Bottom	
a. Deep water or no channel necessary	1.0
b. Soft bottom, no obstructions	2.2
c. Mud, sand and rock outside channel	5.3
d. Hard or rocky bottom at channel edges	9.0
Waterway Complexity	
a. Straight run with NO crossing traffic	1.0
b. Multiple turns > 15 degrees-NO crossing	2.9
c. Converging - NO crossing traffic	5.5
d. Converging WITH crossing traffic	9.0

Passenger Volume

a. Industrial, little recreational boating	1.0
b. Recreational boating and fishing	2.7
c. Cruise & excursion vessels-ferries	5.9
d. Extensive network of ferries, excursions	9.0

Petroleum Volume

a. Little or no petroleum cargoes	1.0
b. Petroleum for local heating & use	2.7
c. Petroleum for transshipment inland	5.2
d. High volume petroleum & LNG/LPG	9.0

Chemical Volume

a. Little or no hazardous chemicals	1.0
b. Some hazardous chemical cargo	2.4
c. Hazardous chemicals arrive daily	5.4
d. High volume of hazardous chemicals	9.0

Economic Impacts

a. Vulnerable population is small	1.0
b. Vulnerable population is large	3.1
c. Vulnerable, dependent & small	5.5
d. Vulnerable, dependent & Large	9.0

Environmental Impacts

a. Minimal environmental sensitivity	1.0
b. Sensitive, wetlands, VULNERABLE	2.9
c. Sensitive, wetlands, ENDANGERED	5.8
d. ENDANGERED species, fisheries	9.0

Safety and Health Impacts

a. Small population around port	1.0
b. Medium - large population around port	2.5
c. Large population, bridges	5.6
d. Large DEPENDENT population	9.0

Analysis:

The participants contributed the above calibrations to the Subfactor scales for the national model. For each Subfactor above there is a low (Port Heaven) and a high (Port Hell) severity limit, which are assigned values of 1 and 9 respectively. The participants determined numerical values for two intermediate qualitative descriptions between those two extreme limits. In general, participants from this port evaluated the difference in risk between the lower limit (Port Heaven) and the first intermediate scale point as being equal to the difference in risk associated with the first and second intermediate scale points. The difference in risk between the second intermediate scale point and the upper risk limit (Port Hell) was generally 2.5 times as great.

Book 4 Risk Subfactor Ratings (Ponce and South Coast of Puerto Rico)

Fleet Composition	Traffic Conditions	Navigational Conditions	Waterway Configuration	Short-term Consequences	Long-term Consequences
% High Risk Deep Draft 6.6	Volume Deep Draft 5.5	Wind Conditions 3.6	Visibility Obstructions 1.7	Volume of Passengers 1.0	Economic Impacts 4.0
% High Risk Shallow Draft 3.5	Volume Shallow Draft 2.6	Visibility Conditions 2.8	Passing Arrangements 3.7	Volume of Petroleum 6.6	Environmental Impacts 6.8
	Vol. Fishing & Pleasure Craft 1.2	Currents, Tides, Rivers 5.2	Channel and Bottom 6.0	Volume of Chemicals 4.2	Health & Safety Impacts 2.1
	Traffic Density 2.5	Ice Conditions 1.0	Waterway Complexity 1.0		

Analysis:

Based on the input from the participants, the following top risks occur in Ponce (in order of importance):

1. Environmental Impacts
2. Volume of Petroleum
3. High Risk Deep Draft
4. Channel and Bottom
5. Volume of Deep Draft

Book 5 (Ponce)

Subfactor	Book 4	Book 5 Results											Combined Results		
	Results	Avg	Std Dev	RA	IER	INI	IAN	IEA	AIS	EAIS	VTIS	VTS	Delta	Rank	Tool
Environmental Impacts	6.8	3.7	1.34	1	4	0	1	1	0	0	3	0	3.1	1	IER
Channel & Bottom	6.0	3.7	0.95	1	0	2	3	1	0	0	3	0	2.3	2	IAN
% High Risk Deep Draft	6.6	4.5	1.84	3	0	2	4	0	0	0	1	0	2.1	3	IAN
Volume of Petroleum	6.6	4.5	1.90	2	3	0	0	1	0	0	2	2	2.1	3	IER
Volume Deep Draft	5.5	4.3	1.57	3	3	1	2	0	0	0	0	1	1.2	5	RA
Currents, Tides, Rivers	5.2	4.0	1.63	3	1	3	0	0	0	0	3	0	1.2	5	RA
Economic Impacts	4.0	3.3	1.16	5	1	0	1	1	0	0	2	0	0.7	7	RA
Wind Conditions	3.6	3.3	0.95	6	0	0	1	0	0	1	2	0	0.3	8	RA
Volume of Chemicals	4.2	4.0	1.33	4	3	0	0	0	1	0	2	0	0.2	9	RA
% High Risk Shallow Draft	3.5	3.4	0.52	7	1	1	0	0	0	0	1	0	0.1	10	RA
Passing Arrangements	3.7	3.7	0.82	7	0	1	0	0	0	0	2	0	0.0	11	RA
Health & Safety Impacts	2.1	2.4	0.70	9	0	0	0	0	0	0	1	0	-0.3	12	RA
Visibility Conditions	2.8	3.1	1.10	9	0	0	0	0	0	0	1	0	-0.3	13	RA
Visibility Obstructions	1.7	2.2	1.32	8	0	0	1	0	0	0	0	1	-0.5	14	RA
Volume Shallow Draft	2.6	3.2	1.48	9	0	0	0	0	0	0	0	1	-0.6	15	RA
Traffic Density	2.5	3.2	1.32	9	0	0	0	0	0	0	1	0	-0.7	16	RA
Volume of Passengers	1.0	1.8	1.14	9	0	0	0	0	0	0	0	1	-0.8	17	RA
Ice Conditions	1.0	1.9	1.20	9	0	0	0	0	0	0	1	0	-0.9	18	RA
Waterway Complexity	1.0	1.9	1.20	9	0	0	0	0	0	0	1	0	-0.9	18	RA
Vol. Fishing & Pleasure Craft	1.2	2.1	1.29	9	0	0	0	0	1	0	0	0	-0.9	20	RA

Legend:

If the acceptable risk level is higher or equal to the existing risk level for a particular subfactor, circle RA (Risk Acceptable) at the end of that line. Otherwise, circle the VTM tool that you feel would MOST APPROPRIATLY reduce the unmitigated risk to an acceptable level.

- IER** = Improve Existing Rules (pilotage rules, standard operating procedures, licensing requirements).
INI = Improve the existing Navigation Information (charts & hydrographic information) for the port.
IAN = Improve the existing short range Aids to Navigation (buoys and lights) in the port.
IEA = Improve the existing Electronic Aids to navigation (LORAN, GPS, GMDSS) in the port.
AIS = implement an Automatic Identification System for the port.
EAIS = implement an Enhances Automatic Identification System for the port.
VSC = improve the Vessel traffic Service Communications capabilities.
VSI = improve the Vessel traffic Service infrastructure (radars & cameras).

Analysis:

This is very consistent with the discussion that occurred about risks in the port area along the south side of Puerto Rico. The mitigations discussed to reduce the risks in Book 4 (above) seem to be best addressed by a simple **improvement to the current system and adjustments to the short range aids to navigation system.**

<u>Scope of the port area under consideration:</u> (The participants addressed the geographic bounds of the waterway)	
Port area	Defined by the port of Yabucoa (Y) to the east and Ponce (P) to the west, including Las Mareas (LM) and Guayanilla (G)
Risk Areas	Add Jobos (J) that includes tugs and barges
	Add the pier at Tallaboa (T) – part of Guayanilla
	Las Mareas, Ponce, and Guayanilla
	<ul style="list-style-type: none"> • A number of groundings outside of Guayanilla • LNG facility going in at Guayanilla • Yabucoa – last six months – deep draft vessel grounding – debate between pilot and master whether or not aground...where bottom was touched
	Condition of the piers and facilities – not captured by the VTM model

Risk Factors	Risks	Mitigations
<p><u>Fleet Composition</u></p> <p>% High Risk Deep Draft Cargo & Passenger Vessels</p> <p>Defined in terms of poor maintenance, high accidents, quality of crew</p>	<ol style="list-style-type: none"> 1. Three largest tanker ports in PR are on the south coast – Guayanilla, Las Mareas, and Yabucoa 2. 50% of the traffic on the south coast are problem ships 3. Category One ships – ¼ to ½ of deep draft ships that call are examined by the CG (from CG – LT Torres) 4. 99.9% are foreign flag, carrying Russian crews. Flags of convenience are used. Oil companies use ships that are up to standard. 5. Language problem with crews of the ships – Russian crews 	<ol style="list-style-type: none"> 1. Mitigation actions in place: <ul style="list-style-type: none"> • Company instructions • Standby tugs appropriate to size of vessel they must handle • Only one company provides tugs in most ports • Two companies provide tugs to the south coast • Do not have tug capability for LNG ships • ECO is currently looking at inspection and maintenance records of tugs • Good equipment costs \$\$ 2. Mitigations actions in future <div data-bbox="1109 835 1563 1381" style="border: 1px solid black; background-color: #fde9d9; padding: 5px;"> <ul style="list-style-type: none"> • Need adequate tugs – establish a standard <ul style="list-style-type: none"> ○ Minimum horsepower requirement ○ Must determine standards for tugs – tonnage, length, width, operating procedures ○ Have the tugs made fast or just escorting – consider narrow channel ○ Consider COTP order 3. Need team work between ships, tugs, and shoreside persons </div> 4. LNG requirements will include – 135,000 bollard pull for tugs 5. LNG – tugs must demonstrate ability to handle the ship – and that the pilots are properly trained 6. Crew competency – improve existing regs standards 7. Consider establishing a pre-arrival check list to assess the capability of the ship and crew

Risk Factors	Risks	Mitigations
%High Risk Shallow Draft Cargo & Passenger Vessels	<ol style="list-style-type: none"> 1. Tugs and barges are kept up. 2. Tug pers may not be totally competent 3. From facility operators – no problems 4. LEE VAC – barges run Yabucoa, Jobos, and Guayanilla – carrying no. 2 and no. 6 F.O. 5. LEE VAC only company running the south coast – owners are investing in improving conditions 6. LEE VAC charters other companies – equipment, at times, may be suspect 	Risks for this factor appear acceptable
Traffic Conditions	Also, look into the future	
Volume of Deep Draft Vessels	<ol style="list-style-type: none"> 1. Larger ships are calling – about 40K to 64K, 70K DWT. Limited to 80K (810-820 feet) 2. Tankers <ul style="list-style-type: none"> • ECO Llectrical has new facility – 1-2 times a month – 948 feet long – LPG – will switch to LNG, then 1 ship per month (24-30 hours at the pier) – at entrance to Guayanilla Bay • Black oil – largest – Yabucoa – 100K DWY • G – 80K DWT – 45 per month • LM – 45K DWT – largest vessel • J – Black Oil • Y – Sun Oil – 1-2 per week – 75% large size vessels • Will not increase in size (due to dock limitations), will increase in numbers of movements 3. Bulklers and containers ship into P – 20 per month 4. Future – mega port – location unknown – between P to Guayanilla – entire area is highly considered. 5. New gas power plant will not be affected 	<ol style="list-style-type: none"> 1. Risk today is at an acceptable level 2. Using a one-at-a time system
Volume of Shallow Draft Vessels <i>Includes foreign fishing vessels</i>	<ol style="list-style-type: none"> 1. Tugs and barges <ul style="list-style-type: none"> • Trends should continue, may decrease if pipelines are built • J – 20 – 25 per month • Corco © – 12 per month • Y – 4 per month 2. Tankers into Guayanilla and pipelines out to the plants 3. Clean air act will guide efforts 4. Chemical, lumber, and general barges into P – 2-3 per month 5. Small freighters into P – 2 per month 	
Volume of Fishing & Pleasure Craft <i>Domestic F/V and PC</i>	<ol style="list-style-type: none"> 1. No fishing vessels 2. Recreational boats – on the weekends – 40 – 100 boats – trailered boats. Marinas in P next to the port 3. New marina in P on west side of the port 	<ol style="list-style-type: none"> 1. When have regatta – cooperative with pilots and the CG

Risk Factors	Risks	Mitigations
Traffic Density	<ol style="list-style-type: none"> 1. Tugs and barges enter without pilots 2. Ships are moved 24 hours a day 3. Pick up fish traps – Las Mareas. Traps in the middle of the approach channel – attempt to maneuver the ship to avoid the traps 	<ol style="list-style-type: none"> 1. Ports are running one ship at a time 2. Local regulations cooperatively established on some of the harbors
<u>Navigational Conditions</u>		
Wind Conditions	<ol style="list-style-type: none"> 1. Prevailing trade wind from the east flowing along the entire coast 2. G – 9-10 a.m. 20-35 kts until 17-1800; also approaching the berth...Coco berth 3. LM – causes crabbing and approaching the berth 4. Hurricane closes all down 5. Higher winds in rain squalls – up to 40 knots for brief period (5-15 minutes) in winter. Casualty in Guayanilla, aground in B1 – fully loaded tanker 	
Visibility Conditions	<ol style="list-style-type: none"> 1. Rain – winter – from the east in a.m., duration for 2 - 3 hours. Generally a brief period, 5-15 minutes 2. Dust (dust drops from Sahara Desert) – drop vis on approach – approach are not visible 	
Currents, Tides and Rivers	<ol style="list-style-type: none"> 1. Alongshore current setting to the west – across the harbor entrances 2. Varies in intensity with water depth – ½ to 1 kt – stronger at Las Mareas (has a narrow channel, too) 3. 1.3 – 1.8 kts – logged; is cross channel, causing vessels to crab 4. Ponce and Guayanilla – wind driven current is more a problem – no current in the harbor 5. On approach, include the wind, sea and swell 6. Lite barges are wind sensitive 7. Loaded barges are behind tugs – 50 – 60 feet and crabbing to the side limits of the channels 8. Heavy rains in all ports cause freshets 9. Las Mareas – freshet carries sand to breakwater and causes silting in the channel 10. Guayanilla – freshet brings slight current and debris 11. Las Mareas – hydraulic affect on approach 	<ol style="list-style-type: none"> 1. Risks seem to be acceptable 2. Current information in G (datum is in Galveston, Tex). Some information is eyeballed. 3. Currents are stable and predictable even though the books are inaccurate
Ice	No ice conditions in the south coast	No mitigation needed
<u>Waterway Configuration</u>		

Risk Factors	Risks	Mitigations
Visibility Obstructions <i>Cannot see ATON or other ships</i>	<ol style="list-style-type: none"> ATON backlighting problems: <ul style="list-style-type: none"> New LNG facility in Guayanilla in way of the approach of the channel – a background lighting problem for ATON Background lighting for ATON common for just about every port along the south coast – Las Mareas (max security prison; ht of eye problem – vertical separation), Guayanilla (range lites are yellow in front of a power plant with yellow lites), P (lited part next to ranges), Yabucoa is OK In P and Guayanilla, height of ranges is not adequate Outbound Guayanilla, can't see east because of the new berth (ECO Electrical) – bigger when ships are moored at the berth In Jobos, unlighted buoys are a hazard 	
Passing Arrangements	<ol style="list-style-type: none"> Jobos – narrow channel Anchoring in middle of channel – Guayanilla – B11 – in way of maneuvering ships No designated anchorage area along the south coast Lightering in Guayanilla In Guayanilla, PPG, ATON buoys are placed in the middle in the channel – private ATON 	<ol style="list-style-type: none"> Consider designating a barge anchorage
Channel and Bottom	<ol style="list-style-type: none"> Bottom soundings in Bahia Jobos and Guayanilla are old and suspect Rocky 13 spot in Jobos is hard Guayanilla – north of B1, 41 foot spot inside of channel, drafting 50 feet (watch the set to the wet onto the rock) LAS MAREAS – two reefs either side of the channel - coral 	<ol style="list-style-type: none"> Realign ATON to better mark the channel Complete a WAMS on the South Coast to discuss unlighted buoys <ul style="list-style-type: none"> Rocky 41 and 13 Insure channel ranges are lined up Insure bottom surveys are completed and up to date VTM tools – improve bottom surveys – improving existing measures Good dGPS information received – Guayanilla and Yabucoa
Waterway Complexity	<ol style="list-style-type: none"> Jobos – have some bends in the channel Tallaboa – 90 degree turn to the east, south of the island, hard left to the pier (Calle Rio) 	
Short Term Consequences		
Number of People on Waterway	<ol style="list-style-type: none"> Cruise ships – 5-6 per year going into P Ferry operations – none 	

Risk Factors	Risks	Mitigations
Volume of Petroleum Cargoes	<ol style="list-style-type: none"> 1. Tanker ports <ul style="list-style-type: none"> • Guayanilla • Ponce • Las Mareas • Jobos • Yabucoa • Tallaboa 	<ol style="list-style-type: none"> 1. Mitigations today: <ul style="list-style-type: none"> • Limited double skinned tankers • One barge is double skin • Consider customized reporting procedures to insure a more rapid response to a commercial grounding
Volume of Hazardous Chemical Cargoes	<ol style="list-style-type: none"> 1. Ponce - LPG 2. Guayanilla – all the way in 3. Las Mareas – 4. Tallaboa – LPG 	
<u>Long-Term Consequences</u>		
Economic Impacts	<ol style="list-style-type: none"> 1. Based on inventory 2. In Coco, 7-15 days inventory 3. Guayanilla – 7-5 days 4. Others – 7-15 days 5. No impact on container traffic – will send to San Juan 	
Environmental Impacts	<ol style="list-style-type: none"> 1. Jobos is a marine sanctuary 2. Yabucoa is a sanctuary 3. Guayanilla is a sanctuary 4. Any incident will move west due to trade winds 5. West side of Las Mareas is sensitive area 6. Includes marshlands, wetlands, endangered species 	<ol style="list-style-type: none"> 1. Goal – minimize impact on environment 2. Meet CG standards for response equipment requirements. 3. Terminals have sufficient equipment to contain the spill until the OSRO arrives 4. 2 OSROs in south coast in G <ul style="list-style-type: none"> • Start time – 5-10 from facility 5. Other OSROs – 1-2 hour response time 6. Vessel spills – terminals cannot control – terminals do respond with clean up equipment 7. Can improve the existing system...more boom, contractors, regs 8. Traffic control can help coordinate response 9. Develop and exercise an action plan
Health and Safety Impacts	<ol style="list-style-type: none"> 1. Power plants will go down I 15 days 2. Cooling water from ocean 3. Yabucoa, Jobos, prevailing winds are toward town 	

